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Keeping time with trees: Climate change, forest resources, and experimental relations with the future

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ABSTRACT

The Anthropocene signals anticipation of unknown ecological volatility. Transformational change necessitates diversified experiments for unpredictable scenarios, accepting that many will fail. This paper uncovers insights on such experiments, from an initially unrelated research project 'following' guitar production networks 'back to the tree'. Across the Pacific Northwest, Hawai'i and Australia, resource actors in liminal positions between forestry and guitar manufacturing pursue new roles as forest stewards, experimenting with multi-species plantings for future use beyond their lifetimes. Cognisant of impending ecological volatility, and uncertain that industrial forestry (defined by monocultural, short-term chronotopes) will sustain supply indefinitely, new cultivation techniques are being trialled, and stewardship practices extended towards trees that they will not themselves harvest. In experimentation, resource actors seek to resolve their own extractive dependencies with understandings of trees and forest ecologies. They also grapple with arboreal time - the temporalities of forests and their growing cycles, material qualities and genetic predispositions - knowing that the trees will mature amidst a profoundly different climate. We illustrate the value of 'legacy' mentalities, enthusiasm for trial and error, and prosaic restorative cultures among resource stewardship actors, focusing on those whose present experimentation responds to lived experience of industrial capitalism's failures. Insights arise on efforts we must all make to craft a world that can survive the future we have wrought. Unpremeditated experimental relations with nonhuman others, and with the future, unfold materially in time and space - not through official policy initiatives, but extemporaneously, on the fringes of formality.

1. Introduction

The heralding of the Anthropocene urges anticipation of unknown volatility. Across diverse spheres – demography, urban planning, emergency and natural resource management – emphasis has shifted from incremental to transformational thinking as risk and uncertainty intensify (Kates et al., 2012; Park et al., 2012). With planetary thresholds exceeded (including climate change), humans must anticipate, plan and make policies for unpredictable scenarios, knowing many such plans and policies will fail (Hulme, 2010; Stengers, 2015). Diverse experiments are thus necessary: in what is grown, where, in how earthly matter is transformed into 'resources' and things made and maintained from them (Carr, 2017; Klocker et al., 2018). At one level, there will be scientific experiments as conventionally understood (for example, in plant cultivation) (Graddy-Lovelace, 2018). At another, are experiments in epistemology and ontology – in how we live and construct economies with and among other beings (rather than in domination of them) (Bingham and Hinchliffe, 2008; Lorimer and Driessen, 2014; Atchison, 2015). In contemplation of 'life without the promise of stability' (Tsing, 2015:2) they will also be experiments in acting for unknown futures – challenging our very underpinning conceptions of time.

In this paper, we reflect on encounters with a group of unassuming actors already experimenting in such a vein: workers on the fringes of mainstream industry, proceeding with initiatives beyond the boundaries of familiar frameworks, and experimenting along a stretched temporal plane. We have for the past five years pursued a research project that 'followed' guitars, and the timbers they are made from

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(known as tonewoods), 'all the way back to the tree'.[1] Our goal was to start with the completed instrument – the guitar – and trace it 'in rewind', to discover its production methods, input materials, and upstream ecological origins. In this approach, we were inspired by Ian Cook's (2004) methodology to 'follow' everyday things, disassembling 'finished' commodities to trace genealogies of manufacture, processing and resource use. The method gets 'behind the fetishism of commodities…[to] integrate the historical geography of space and time within the frame of all our understandings of how human societies are constructed and change' (Harvey, 1990: 428). Our journey ended up somewhere else entirely: a rambling, nonlinear exploration of uncertain spaces characterised by material resource scarcity, political contestation, and upheaval in existing ways of doing things (cf. Tsing, 2015). A combination of poor forest management, short-sightedness and the perversities of global forestry markets have resulted in worldwide shortages of guitar timbers, or in some cases, outright bans on their use. Over-extraction has threatened species, with international regulation of timber trading tightening (Anonymous, 2018). A crisis of resource security and accompanying scarcity has unfolded (Gibson and Warren, 2016), emblematic of the Anthropocene's excess of sustainable planetary thresholds. Resource security concerns have forced manufacturers, suppliers, craftspeople and guitar players to reassess their instruments, their component materials, and their ecological entanglements.

Key are material and temporal tensions arising from the fact guitars are made from wood extracted from centuries-old trees, often necessarily so for reasons of engineering, acoustics and aesthetics. The guitar industry must interface with forestry. Yet species that guitar-makers depend upon, with rare exception, do not feature in contemporary plantation forestry, for they grow too slowly and must be massive to be made into guitars. Time is, in forest economics, "measured in years or decades but never in centuries" (Raphael, 1994: 169). An earlier era of state-sponsored foresters seeking to trial varieties and alternatives for unknown future industrial applications (Gibson and Warren, 2018), has given way to a highly calculative sector, dominated by financial market actors. Nowadays forestry is locked into the growth and harvesting of singular species chosen and selectively bred for rapid growth, habit, and a settled position within algorithms of value, cash flow and returns on investment (Prudham, 2005; Osborne, 2015). The guitar industry, worth US$1.6 billion p.a. globally and the largest sector of musical instrument manufacturing, is tiny compared with forestry's main consumers in construction, paper and more recently carbon finance. Major corporate players who dominate global forestry have little time or market inclination to invest in diverse, longer-term, smaller-return initiatives to meet demand from niche industries for timber from centuries-old trees. The guitar industry in turn has grappled with dwindling sources, scandals linked to illegal logging, and a growing sense of an unknown future.

In this paper we document and analyse experiments undertaken by a small group of resource actors in response to such challenges, focusing especially on attempts to reformulate temporal relations with trees and forests, and in so doing, reformulate relations with unknown planetary futures. Earlier in their careers, these actors did not intend to become forest stewards – although all profess a life-long love for plants. Rather they have assumed forest stewardship roles after personal experiences of industrial forestry's spatio-temporal failures, especially its inability to sustainably manage forests to supply high quality timbers from centuries-old trees. Cognisant of forest ecology, but also the future needs of craft industries, a group of resource actors are seeking to plant, grow and care for mixed forest plantations for the benefit of generations beyond their own. In so doing, they combine a multispecies ethic with conceptions of temporality beyond those of industrial forestry – an unfolding and unpremeditated experiment for the Anthropocene.

Forestry's accepted practices portend a disturbing scenario in which a major resource industry is poorly positioned to cope with the Anthropocene's predicted upheavals (Allen et al., 2010). Climate change "will alter species ranges and change forest communities to [a] mixture that may be both unfamiliar and unprecedented" (O'Hara, 2016:3). Global warming has already altered the geographic distribution of trees, insects and pathogens, posing "serious threats" to forest ecosystems (Ramsfield et al., 2016: 245). Widespread insect eruptions in North America, Europe and Australia have followed changed rainfall patterns that stress trees, and warmer winters fuelling unhindered growth in beetle populations and rapid spread of fungal infections (Dooley et al., 2015; Goodsman et al., 2018). The consequence, widely reported in global media, has been unprecedented die-offs of millions of trees. Recent global estimates of extinction threats conclude that without meaningful climate change mitigation, the Amazon could lose 69 percent of its plant species (Warren et al., 2018). Over half of all viable habitat for mainstream forestry species such as black spruce (*Picea mariana*) may be lost by 2060 (Joyce and Rehfeldt, 2017; McDowell et al., 2016:295). Forestry experts acknowledge the need for 'new paradigms of ecological management' (Taylor et al., 2013:225) to transform practices now in anticipation of an 'era of uncertainty' (Whittet et al., 2017).

While much of the climate-related debate in forestry research has centred on invasive pests and 'fear of an alien future' (Taylor et al., 2013), for the guitar timber people profiled below, the fear is more of a monocultural future, with forestry dominated by single species they cannot utilise, locked into short temporal cycles. As old growth logging ceases, industrial forestry constitutes expansive plantation forests devoid of species diversity or successions of trees growing to a size enabling products such as guitars to be made. In response, resource actors in the guitar industry are presently taking matters into their own hands. They have taken on stewardship responsibilities for valuable rare legacy stands that have survived from earlier eras, and recently planted mixed species of trees in diverse places – on their own properties, on others' private land, in partnership with manufacturing companies, cattle ranches and Indigenous-owned and managed schools – so that wood for future use in their craft may be available beyond their own lifetime. This article traces such actors and their efforts, as a distinctive form of Anthropocene experiment in ecological and resource relations, reconfiguring space and time.

The resource actors profiled here plant and care for forests personally to secure timber availability for the guitar industry's future. They do so in part because of philosophical troubles with their own reliance on cutting trees for human exploitation (cf. Almassi, 2017), but

[1] We have in this paper avoided a dedicated 'methodology' section, in order to not disrupt the narrative flow. Nevertheless, explanation of our empirical work is warranted. Our project began with firms and individual craftspeople ('luthiers') who make guitars. Interviews were undertaken with managers and workers within guitar manufacturing firms, and with luthiers, in the United States and Australia. Workshops and factories were visited and toured. Interviewees with guitar makers referred the researchers to their specialist timber suppliers (who were subsequently interviewed); and from there, with sawmillers and foresters. Some 75 interviews have thus far been conducted over five-years, across the United States, Canada, Australia and New Zealand (with further fieldwork pending at the time of writing, in Brazil, Spain and China). Interviewees included firm CEOs, factory/sawmill managers, and shopfloor workers, covering large and small firms. Questions ranged from input raw materials and production processes, to impacts of resource scarcity. Interviews were conducted within guitar factories, woodworking shops, sawmills, forests and plantations, then subsequently transcribed and coded manually for emergent themes. While this paper focuses on the spatio-temporal aspects of resource actors' forest experiments, elsewhere we discuss issues of global production networks, resource scarcity, materiality, 'nativeness' and historical resource endowments (Gibson and Warren, 2016, 2018). The interviewees profiled here were revisited at least twice (and in one case, half a dozen times) over a period of five years. They are quoted with permission in line with our institution's prevailing ethics committee protocols, though on occasion, quotes are anonymised to protect participants, cognisant that in the highly specialist guitar tonewood industry, anonymity is difficult to protect. For further discussion and elaboration on method, see Gibson and Warren (2016, 2018).

also because of disappointment with mainstream forestry's extraction regimes and low-value, short-term thinking. Experiments with trees and forests are not 'wild' or heroic acts (cf. Lorimer and Driessen, 2014), but rather 'present practices of care and recuperation' (Osborne, 2018:5). With 'modes of acknowledgement, humility, and discernment' (Hatley, 2012: 1), resource actors seek to resolve their own dependence on resource extraction, with considerations of ecological ethics and intergenerational equality. Such acts, largely kept private, emanate from a 'prosaic restorative culture' (Carr, 2017: 642) burgeoning on the fringes of forestry, rather than as a principled critique from beyond: a modest environmental project building new relationships between trees, place, and networks of differently positioned humans (cf. Kirkman, 2012; Brace and Geoghegan, 2010). Using a conceptual framework influenced by critiques of 'capitalism's temporal compulsions' (Castree, 2009:26) and more recent more-than-human thinking in environmental humanities, we make sense of these actors and their grounded experiments with open-ended temporalities, embracing unknown horizons in contrast to corporate actor's truncated timeframes. In what follows, we first review conceptions of time, bringing into dialogue social theory and environmental humanities thinking in order to contrast industrial capitalism's time-spaces with those of forests and trees – *arboreal time* – before introducing the guitar industry's resource actors at the core of our narrative. We profile their backgrounds, skills and involvement in timber and craft, before discussing issues of land access, arboreal time, and their care for trees mindful of the needs of future generations.

2. Asymmetries in arboreal time

Following guitars, timber and trees empirically has meant consulting diverse literatures across economic geography, political ecology, economic history, forestry, music history, economic botany, climate change adaptation, anthropology and environmental philosophy. Here, we slice through such diverse influences, narrowing the focus to how space and time interact in relation to timber as a material resource.

At the heart of our analysis is a conceptualisation of asymmetrical spatio-temporalities: the normalised, linear timescales patterning spatial practices and values in industrial forestry, set against *arboreal time* – the stretched and inchoate temporalities of forests and trees. This perspective moves beyond linear clock-time (where time is viewed as passive and linear, a backdrop to unfurling events) and beyond presentist conceptions of space, to acknowledge space and time as co-produced, and 'conjoined ontologically' (Massey, 2005). Multiple chronotopes – distinctive configurations of time and space – structure existence (Bakhtin, 1981). Chronotopes are 'constructed, maintained, lived, multiple, and a more-than-human concern' (Metcalf and van Dooren, 2012: v). And certain human chronotopes dominate the governing of life, becoming 'regimes of time' (Abrams, 2014:129) produced and processed by planners, investors, scientists – as powerful tools 'for producing, managing, and/or undermining various understandings of who or what is in relation with other things or beings' (Bastian, 2012: 25).

Political-ethical questions arise from our relationships with time: how do communities, planners or industries narrate time and space? How are space-time regimes reinforced, determining 'who or what they choose to keep time with' (Bastian, 2012: 25)? Across political ecology, economic geography and anthropology is a consistent critique of how capitalist space-time is structured (Castree, 2009). With the advent of railways, cities, futures markets and universal clocks, time and space were more tightly twinned and compressed, standardising time measured against constants (Cronon, 1991). Industrial capitalism, in joining together spaces near and far, came to rest on 'abstract time-reckoning', which 'acts as a universal measure of value' (Bear, 2014: 3).

Nevertheless, capitalism's abstract chronotope always comes into conflict with 'concrete experiences of time' (Bear, 2014: 3). As Wajcman (2015:3–4) argues, 'It is simply impossible to disentangle our notion of time from our embodied habitual involvement with the socio-material world'. Among such concrete experiences of time are those resulting from planetary forces (day/night, seasons, atmospheric circulations and ocean oscillations) and those of diverse beings, including of trees and their cohabiting flora and fauna, whose 'metabolic rhythms', polyrhythmic lives and interdependencies shape biodiversity's kaleidoscopic, nonlinear timescales (Myers, 2017; Gallan and Gibson, 2011; Tsing, 2015; Myers, 2017). Social theory 'has given too little notice to the formation of distinctive timescapes formed from the collision of social and natural time under capitalist modernity' (Prudham, 2005:117). More-than-human thinking has created opportunities to decentre linear time and its anthropocentric teleologies, observing experiments in time-keeping with other beings (Kirkman, 2012; Wright, 2012; Rose et al., 2017). Such experiments reframe the politics of conservation, nativeness, restoration and extinction.

Meanwhile, human actors wrestle with capitalism's abstract space-time reckonings. Capitalist chronotopes are 'navigated through concrete labour and the everyday' (Krohn-Hansen, 2018:180). In spaces of work (waged and unwaged), people are 'forced to live with contradictory and clashing social rhythms' (Krohn-Hansen, 2018:180). The guitar timber actors encountered below navigate capitalist chronotopes in concrete experiences of their work, while also seeking other kinds of spatio-temporal relations with trees and forests. Amidst dominant chronotypes, other temporalities are forged (Gallan, 2014: 55). Evading assumptions that 'the future is that singular direction ahead', multiple futures 'pop in and out of possibility' (Tsing, 2015: viii), an 'extrapolation or amplification in thought of practices and ideas that are *already taking place*' (Purcell, 2013: 23; emphasis in original; see also Lefebvre, 2003). In the empirical case here, resource actors seek to envisage and enact alternative futures, overcoming obstacles that arise from corporate-dominated forestry, and its distinctive space-time reckonings.

2.1. Industrial forestry's chronotope

Industrial forestry's chronotope is dominated by thinking 'embedded in the reductive linearity of Modernist time' (Wright, 2012:110). The spatio-temporal sequence can be summarised as follows: cut 'old growth' (i.e. pre-commodified) forests, to replace with monocultures of selected high-yield species, repeatedly planted and cut as quickly as possible to maximise the 'sweet spot' of returns on capital investment (Maser, 1988; Prudham, 2005).[2] Steps in the sequence – first planting, cultivation, harvesting, second planting, and so on – seek to manipulate the temporality of trees, abstracting 'fibre' as the alienable, commodified unit of output from the 'whole' forest (Castree, 2003). The goal is to selectively grow and harvest single species in the most efficient manner to deliver commercial material.

In so doing, foresters confront the dilemma that growth times exceed the normal acceptable periods in which capitalist investors expect returns, and thus model costs and profits to gauge future opportunities (Boyd et al., 2001). In their study of longer-term trade-offs from temperate forestry, Sutherland et al. (2016:61) found that multiple ecosystem services recovered over a 200+ year timespan 'along non-linear trajectories and at markedly different timeframes' from industrial forestry. Even the most patient capitals – perhaps pension funds – balk at the timespan and associated uncertainties of forest ecology, often deeming them too risky for investment (cf. Christophers, 2018). Thus, timber companies 'cannot afford to wait for their trees to produce to maximum capacity. In order to turn a profit, they reap the returns from

[2] In many world regions the initial loss of biodiverse 'old-growth' forests occurred from roughly the 1600s to the 1930s, in an extended 'rape and plunder' era of colonial logging and clearing (Dargavel, 1995). Clearings nevertheless continue apace in many places, not just in the less affluent Majority World (Anonymous, 2018), but also in many parts of the affluent West, notably British Columbia and Queensland.

an early harvest and quickly invest in a new crop' (Raphael, 1994:164). In other words, capitalist time-reckonings must confront the exigencies of arboreal time.

Timber interests thence 'take hold of and transform biological time and biological organisms in the production of commodities from natural inputs', pursuing 'all manner of intensive breeding and cultivation schemes aimed at industrializing organisms' that we call trees (Prudham, 2005:117). Experimenting with new varieties and hybrids is needed to speed up harvest cycles, but in forestry this is problematic, because of 'delays and lags larger than anything encountered in agriculture' (Prudham, 2005:117). Confronting arboreal time-spans measured in decades – even for the quickest growing commercial species – generates uncertainties, particularly in terms of the realisation of value, which spook market actors. Privatised, corporate, shareholder-driven forestry is thus compelled by market imperatives to take the monocultural pathway in service of capital accumulation to enable the flow of dividends to shareholders. But also, corporate forestry actors are unable to calculate exchange value (i.e. prices for logs) over a longer-term trajectory, cope with cash-flow adjournments or manage unfamiliar species – limited materially (in terms of required adjustments in expertise) and in terms of the likely market for their sale.

Foresters are thus increasingly averse to risky experiments, sticking to proven calculative algorithms and species that deliver more knowable returns. Further preventing experimentation in species diversity and length of growing cycles are a combination of hands-off investors; strong adherence to within-group norms (a cultural insularity producing limited innovation, research and development); and extensive fixed capital invested in sawmills, automated machinery and blades geared to cut only timber of certain dimensions, from the narrowly chosen high-yield, high-return species (McIlhenney and Hayter, 2014; cf Dowd et al., 2014).

The result is, as Maser (1988:9) put it, a 'forest of short-term absolutes': growing single tree species along a utilitarian, linear resource timeframe. The plantation forest 'sits firmly in a timeline that denies the agency of nonhuman life within it and its connection to… people' (Wright, 2012:110). Contemporary plantation forestry appears unwilling to diversify or to elongate its time horizons, compelled by the need to deliver predictable returns to investors, and locked-in to select species, mills and known, sizeable wholesale markets. Somewhat counterintuitively, industrial foresters do not keep time with the trees, or with the succession cycles of mature forests. Rather, forests, trees, and the everyday working practices of foresters themselves are abstracted in spreadsheets, coerced into keeping time with the expectations of shareholders and government agents.

This is the backdrop against which resource actors in the guitar industry have sought to recalibrate relations with trees and forests. In the case of guitars, the vibrant materiality of timber is key (cf. Bennett, 2010; Martinez-Reyes, 2015). Guitar makers require timber parts with distinctive cellular properties and aesthetic appearance: especially wide, quarter-sawn boards (cut perpendicular to growth rings). While retaining structural integrity, each part, as well as the combination assembled together, must reverberate acoustically in an efficient and pleasing manner (Bennett, 2016). A good guitar is thus a 'difficult compromise between lightness and strength' (Gioia, 2013:32). Forestry's short-cycle reproductions of lower-quality (and unsuitable) monocultural species fails to meet guitar makers' needs for old-growth trees from places with high and consistent yearly rainfall, producing ideally-spaced straight grains on wide boards: Adirondack and Sitka spruces (*Picea rubens* and *sitchensis*) from North American coniferous forests and, from the tropics, rosewoods (*Dalbergia* spp.), mahoganies (*Swietenia macrophylla*) and ebonies (*Diospyros crassiflora*) (Greenberg, 2016). As industrial forestry settled on its narrow range of species for high-yields in shorter timeframes, growing the above guitar species to sufficient size proved unviable. Present guitar-making maintains the preference for certain timbers, but available trees of sufficient girth are scarce (in the case of spruces), or are restricted from use, protected by the Convention on the International Trade in Endangered Species (CITES) (as in *Dalbergia* species). As the guitar industry experiences disruptive transformation (Gibson and Warren, 2016; Greenberg, 2016), several alternatives have been trialled and incorporated into guitar-making, though many of these are also under pressure from overharvesting.

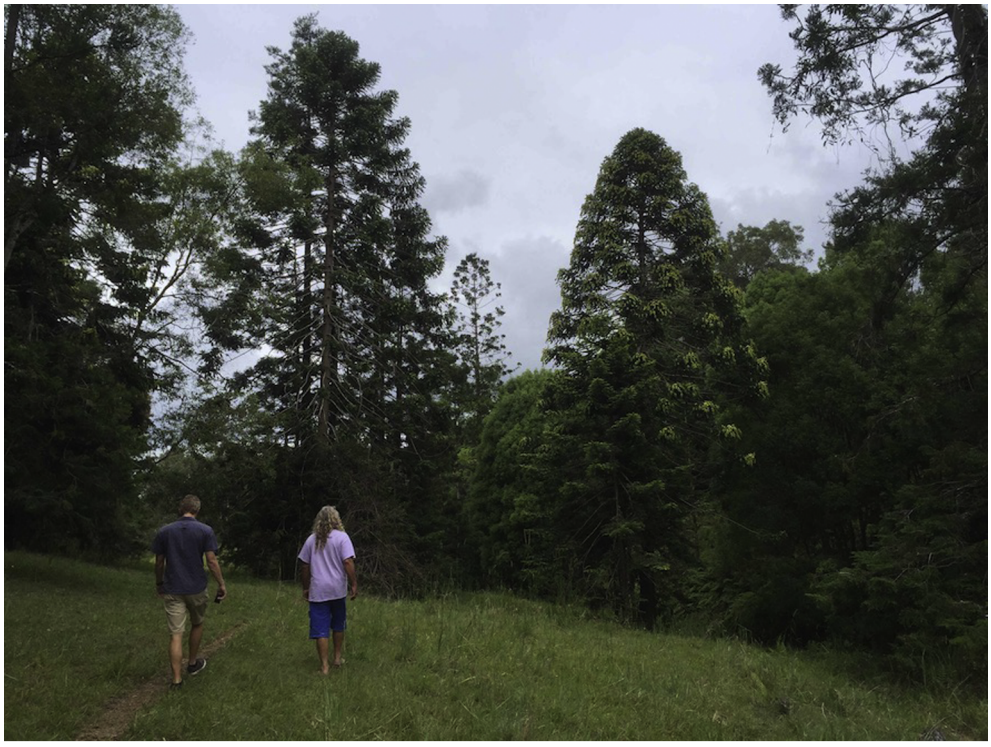
Another reaction has been to question total dependence on industrial forestry, with guitar makers and timber suppliers instead adopting new roles as forest stewards. In what follows, we encounter such resource actors and their 'experiments in co-existence' (Atchison, 2015:1697), growing trees for future use beyond their own lifetimes. To this, guitar timber resource actors bring combinations of humility, expertise (ecological, acoustic, arboreal), and an openness to imagine other space-time horizons.

2.2. Foresting experiments

Our research project resulted in encounters with manufacturing executives and workers, timber millers, brokers, and foresters. Among these were a distinct group at the interface of the craft and timber industries: people who locate, value, manage and supply specialist woods. Such resource actors' daily working lives involve mediating asymmetries between industrial forestry's time-reckonings and the rhythms of arboreal time. Some are dedicated timber suppliers for the musical instrument industry, splitting their time between managing small specialist sawmills and scouting for logs in diverse places. Others are makers themselves – in the guitar industry but also other allied fine timber industries such as furniture-making – who have by necessity become experts in resource procurement, and more recently in forest stewardship. They wear both ecological and resource extraction hats, often describing themselves in paradoxical terms as 'greenie-loggers' who interchange idioms and topics of conversation as they interact with foresters, traders, ecologists and musicians.

The temporalities of such work are irregular, characterised by peaks of intense activity (e.g. around times of pruning or seasonal log procurement), interspersed with periods of down-time, personal and work-related travel (the latter often involving international trips to reconnoitre, salvage and verify log supplies). They interact with industrial foresters in certain moments of timber procurement, while in the ebb and flow of scouting and travelling new information is gathered, conversations are had, and space emerges to explore new and interesting things. They share a disappointment with corporate forestry, and are motivated by curiosity and sense of care for trees and the craft activities that depend upon the availability of fine timbers. In this vein, they have initiated experiments in legacy stand stewardship, tree propagation and planting.

None of them conform to a stereotype or do exactly the same thing. David Kirby, along with his partner, Kate, and son, Sam, runs Kirby Fine Timber, a tonewood supplier operating from a rural property in southeast Queensland. David is highly-regarded for developing expertise in Australian native timbers for guitar-making, notably bunya pine (*Araucaria bidwillii*), Queensland maple (*Flindersia brayleyana*) and blackwood (*Acacia melanoxylon*). David obtains bunya and Queensland maple from state forestry's 1920s legacy plantings (see Gibson and Warren, 2018), while blackwood is salvaged from a 60-acre Tasmanian farm in which they have invested. Bunya and maple – as well as other tropical and subtropical tonewood species (notably blue quandong, *Elaeocarpus angustifolius*, which is used by Maton Guitars in Melbourne for electric models) – are cultivated as 'legacy stands' on Kirby Fine Timber's Queensland property. David also stewards two stands of mixed hardwood trees planted on a cattle station in the 1920s, land at Eumundi, an hour away, that he negotiated access to and manages for owners (Fig. 1). Known for his eccentric and informal style, David excels in verbal communication and maintains trusting personal relationships, while pursuing new experiments on the basis of trial and error, accepting failure is part of the process.



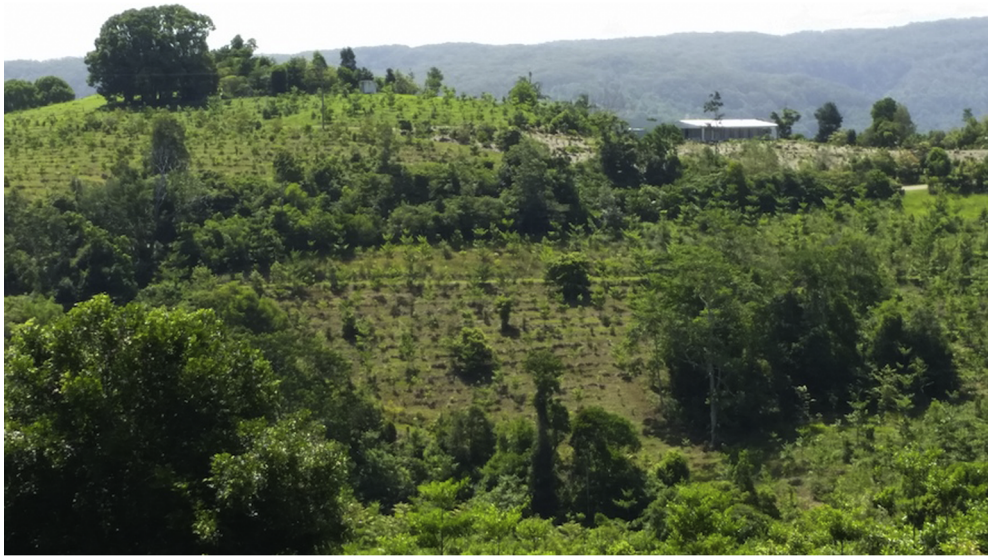
(a)

(b)

Fig. 1. (a) David Kirby leads the authors to the Eumundi legacy stands he manages. Directly ahead is a healthy bunya pine (*Araucaria bidwillii*) with its distinctive domed-crown, intended to become guitar soundboards in decades to come; (b) Kirby prunes juvenile bunya pine, following a practice learnt from retired foresters who trialled bunya plantations in the 1920–1950s. (Photo: authors.)

Further south, Tony Kenway is a high-end furniture maker on the New South Wales Far North Coast. We encountered Tony following the trail of timbers into allied industries. As well as making a living from commissioned furniture, Kenway is a forest ecologist and land manager whose business, Building Forest Designs, partners with private landholders to replant high-quality hardwoods for future purposes (including instrument manufacture) in forest stands throughout the region. These are what he calls 'mixed species cabinet timber plantations'

(a)



(b)

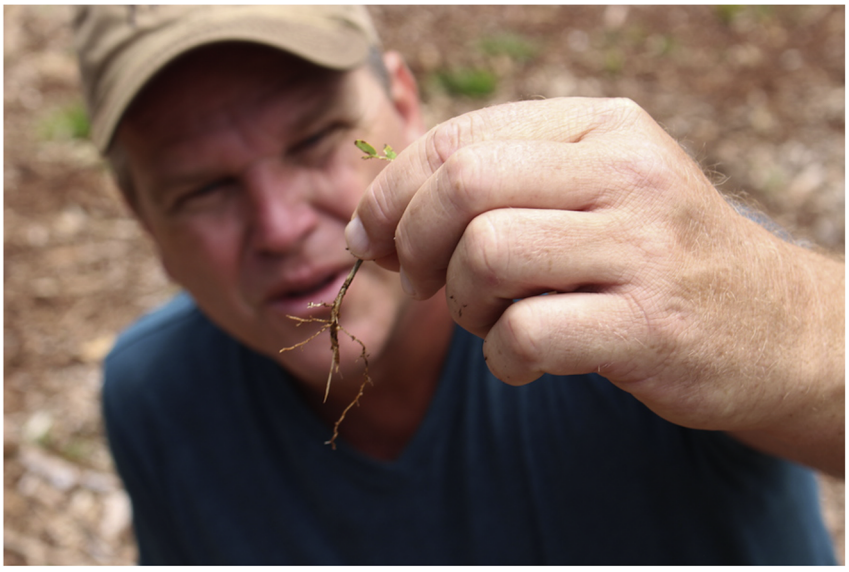
Fig. 2. (a) Tony Kenway shows the authors self-propagating blue quandong (*Elaeocarpus angustifolius*), an electric guitar species, at a 'mixed species cabinet timber plantation' on the New South Wales Far North Coast; (b) a landscape view of one of Kenway's newly planted mixed species stands. (Photos: authors.)

(Fig. 2),[3] planted with white beech (*Gmelina leichhardtii*), silver ash (*Flindersia bourjotiana*), blue quandong, blackwood, red cedar (*Toona ciliata*) and blackbean (*Castanospermum australe*). (The latter, endemic to the region, is used experimentally as a fingerboard material by Australian guitar brand, Cole Clark). Somewhat more formal in style than Kirby, Kenway seeks to operationalise state incentive schemes for private landholders with whom he partners.

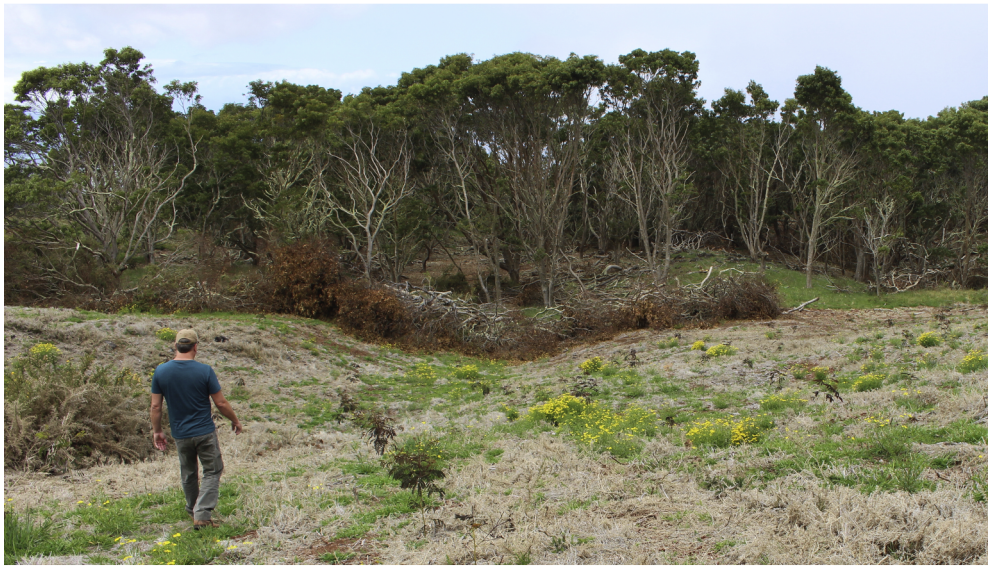
Diagonally across the Pacific Ocean is a dedicated specialist sawmilling company in Washington State, USA: Pacific Rim Tonewoods (PRT). PRT was established by Steve McMinn from a personal passion for timber and guitars. The company's daily operations are managed by Eric Warner, and their chief log buyer, Kevin Burke. PRT sits at the fulcrum of a suite of experiments in growing trees for future use in guitar-making, led by Steve, Eric and Kevin along with their long-term R&D partner-consultant, David Olson. While their core business is processing Sitka spruce for acoustic guitar soundboards, they have invested in various tree-growing experiments that focus especially on alternative species: western big leaf maple (*Acer macrophyllum*), which is endemic to their region, and koa (*Acacia koa*), a substitute for rosewoods that grows only at certain elevations in Hawai'i (Fig. 3). While PRT adopt a scientific approach (e.g. planting controls elsewhere to compare for environmental variables), like Kirby in Queensland there's very much a sense of 'an openness to exploration and risk' (Westgate, 2018:3): of trial and error and 'play' in the way trees are propagated, planted, cared for, and cut (cf. Harder, 2005). McMinn and Burke often explain what they're doing in the languages of horticulture and ecology, their enthusiasm palpable (cf. Brace and Geoghegan, 2010). Against the everyday business of slicing logs into guitar parts, they gain energy and inspiration from resource experiments, and the fact that they're open-ended.

Meanwhile, also in Hawai'i, Bob Kalani Russell is a Hawaiian expert in koa who collects timber for use in surfboard, furniture, ukulele and guitar making, but also restores and manages native mixed koa-'ō'hia

[3] Unless otherwise stated, all quotes here are from recorded interviews conducted since 2015.



(a)



(b)

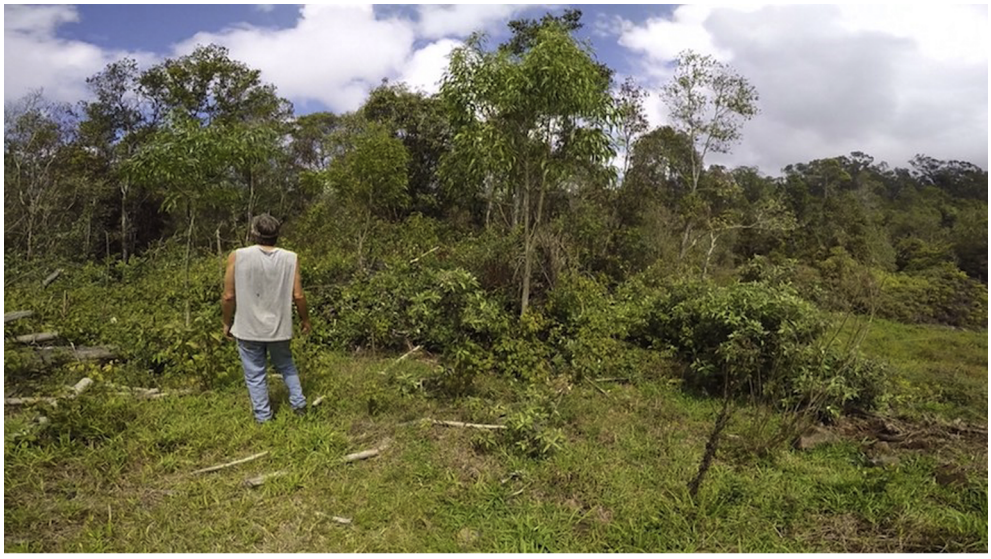
Fig. 3. (a) Scott Meidell, Haleakala Ranch, Maui, shows a self-germinated *Acacia koa* sprout; (b) newly planted koa, at Haleakala Ranch, Maui. In the background is the 1980s planted stand from which guitars were made and new plants propagated vegetatively (Photos: authors).

forests (*Acacia koa-Metrosideros polymorpha*) on private lands (Fig. 4). Bob enjoys close relationships with other Hawaiian elders and makers who cherish koa in their wood crafts, while maintaining relationships with local sawmills in mainstream forestry. Quietly spoken but almost manic in his enthusiasm for koa, Russell benefits from on-going conversations with fellow Hawaiians about native forests, flora and fauna, pre- and post-colonisation – enmeshing a lively oral tradition with contemporary private forest stewardship.

All these actors are highly knowledgeable about plants. Kirby trained in horticulture before specialising in guitar timbers. Kenway completed a trade in cabinetry-making and became an award-winning fine furniture maker. Bob Russell's background is in woodworking, running a small but successful company called Kona Koa, specialising in the supply of raw and milled koa. Kevin Burke attended art school before working in orchard and retail nurseries and landscape design, en route to becoming PRT's log buyer. David Olson trained as an ear, nose and throat surgeon (specializing in ear acoustics), but also holds a master's degree in the paleoecology of ancient spruce forests. Steve McMinn put himself through college working on a trail crew for the Park Service, building boats, and teaching woodwork at Western Washington University. He recalled that

> my dad was a forester, so we grew up with timber. We moved some, and we would always plant trees wherever we went. We would plant trees for shade, to screen views, for fruit. We would plant oddities. And we always made things from wood: snowboards, furniture, houses and so forth. I grew up with wood, working it, and thinking that trees take a long time to grow.

They all read voraciously and eclectically. Kirby keeps boxes of printed academic journal articles relating to forest ecology, tree selection trials, and environmental history, consulting them regularly. Kenway also keeps up with policy developments to support reforesting on private farms. Interviews with these actors invariably turned to the topic of the latest research or developments. At PRT, McMinn, Olson and Burke collaborate with and seek the advice of scientists from the US, Canada and Europe. When we visited Kirby for a return interview in 2017, a long conversation ensued from his reading of Peter Wohlleben's (2016) *The Hidden Life of Trees*, on the topics of the longer-term



(a)

(b)

Fig. 4. (a) Bob Kalani Russell shows the authors newly planted Acacia koa in restored forest on private land, Hawaii Island. (b) Russell explains whereabouts curly figure will be found on a huge old fallen tree.

temporal cycles of forest succession, soil quality and interdependencies between trees and mycorrhizal fungi. They appreciate arboreal time and the value of forest decay as well as tree growth.

On several occasions we witnessed in situ interactions with foresters and procurement workers from guitar manufacturing companies – conversations that unfolded at pace in the language of trees (boles, internodes, epicormic buds, diameter at breast height, succession, rotation, etc.). Looking at cut logs and boards, they are able to decipher the age of the tree, and a range of environmental influences: whether the tree grew vigorously or stressed, slowly or quickly, suffered drought or pest attack; even which aspect or slope the tree grew on, and whether it grew proximate to other competing trees.

With such knowledge and experience at hand, they level various criticisms at mainstream forestry and its limitations. Lack of foresight was a universal theme. Quotes such as the following were typical:

> there's no doubt when you go into clear-fell forestry, it's depressing. It's in the nature of just ripping out every fucking thing that's there. It's a crop, like a crop of oats. It takes a certain amount of time and they come in and they strip it bare and they plant it again.

The preference for single-species monocultural plantations, and an aversion to new experiments, also drew consistent criticism. In one person's view,

> It's very hard to get them to talk about different species. The trouble with forestry is, experiments are poo-pooed because you don't find out for 60 years whether it worked or not… Most forestry is 25 years. Some they're pulling out in 15 years. I don't know where that mentality came in. It's like 'what the fuck, you're dealing with trees that have a 100-year cycle!'

Meanwhile, mainstream forestry eschews the guitar industry's desire for comparatively tiny quantities of rare species, in favour of larger customers who order predictable quantities of selected species. As PRT's Kevin Burke explains: 'It's like a Caesar salad, with some romaine lettuce, some croutons and other things. There's lots of lettuce, but we

don't want it. We only want a few croutons. But the big players want to sell the whole salad'.

The various experiments undertaken by the guitar resource actors respond to such circumstances, and amidst growing scrutiny of old-growth logging, anticipate future resource scarcities. As Steve McMinn from PRT succinctly put it, 'the world's primary forests are nearly mined out. If you want wood for a specific purpose, you need to grow it'. Hence, as their careers have evolved and they have worked-up the financial capacity and freedom from constraints of shareholders and management to fund such experiments, they now additionally seek to cultivate trees needed by the guitar industry and other wood-based crafts, for future generations.

2.3. Making time and space for trees

From the outset, a challenge is securing suitable land to experiment with guitar timber foresting (cf. Klocker et al., 2018). The debate about management and use of public forests looms large. Government forest agencies that purportedly manage forests in the public interest, are seen to have joined up with corporate interests. In this view, forestry has promulgated 'cheap nature' (Moore, 2017:595) via monoculture, short-rotation models. As one participant explained:

> For close to a hundred years, $40 a cube [cubic metre] is the standard royalty you pay to the government for hardwood logs out of public land. $40 a cube! For years they've held it low for economic reasons – effectively as a regional development subsidy. It never ceases to amaze me, the stupidity of the short-term outlook when it came to managing forests. It's been like that for so long that it wasn't worth planting a tree, financially, for timber. So, no one did. Any farmer that can do their sums will say that ain't worth it.

The side-effects of this dominant model of public forest management are that the needs of smaller industries such as guitar making are not considered, while biodiversity goals are compromised. With public lands effectively closed-off to experiments, the avenues pursued rest largely on accessing private land, either directly owned, or owned by others who are sympathetic philosophically (and/or convinced, economically) to the principles of 'legacy' forestry experiments.

In Queensland, David Kirby planted out the family's 26-acre rural property with a variety of species suited to guitar manufacturing. An agreement was forged with a private landholder near Eumundi (an hour away) to restore forest and manage heirloom stands planted by the landholder's great-grandfather in the 1920s. Within the stands are bunya pines, hoop pines, quandong, red cedar and brown pine (*Podocarpus elatus*). 'It doesn't look much from the outside', says Kirby as he takes us to visit the Eumundi stand, 'but once you're in here, you go "geez!"'.

Tony Kenway convinced several private landholders in far north coast NSW (a subtropical rainforest region known as 'the Big Scrub country') to sign-up for government incentives encouraging landholders to plant diverse, longer-term trees:

> This was in the early 1990s, and I realised through talking to the forestry guys, some of them totally agreed with our concept, but the politics got in the way. The National Party controlled the state forests back then. On [the] other extreme was the Green movement saying "don't cut any trees down". Somewhere in the middle I was saying "it's not about don't cut trees down, and it's not about just monoculture and bulldozing them, and having a rotation forest". Especially on this land: rainforest land with steep slopes, high-value soil, high-value land, lifestyle… A model could work that is a mixed species cabinet timber plantation.

As 'the industry representative that knew about these species', Kenway then partnered with an economist and the local Landcare group to write a position paper on the viability of mixed species plantations. Further regulatory amendments allowed small land owners to register and grow authorised plantations within a certain code (Forestry Act 2012, Part 5C) that guaranteed harvesting rights:

> People buy land up here and ask "what can they do with it?". I say "oh we happen to grow some of the best timbers in the world here". So, put them in, and as the trees grow, when you've got a forest, there's minimal maintenance, and it's a native forest; it becomes a beautiful property. I put roads in and walking trails and waterfalls. And then it can also be selectively harvested for high-value hardwoods by future generations.

Interested landowners were approached, and in the mid-1990s the first trials commenced. By 2015, Kenway had a staff of 15, managing 500-acres of private land planted with 160,000 rainforest trees that had an estimated market value of A$20 million. Kenway has successfully adapted harvest security legislation to his model of experimenting with what he calls 'rebuilding rainforest landscapes'.

Across the Pacific, in 2015 PRT purchased Utopia, a 53-acre farm on the Skagit River floodplain and a short distance from PRT's sawmill, 'after looking for about a year for land suitable to our growing interest in a Big Leaf Maple plantation'. The site floods annually, and maple, which flourishes in the boggy rich soil of river flats, grows at every corner on neighbouring blocks. Since then, PRT have established a trial big-leaf maple propagation and plantation site, as well as a second trial orchard site nearby. In Burke's words,

> We have been moving as quickly as possible, building the infrastructure, greenhouse, barn, and water systems needed to support these trials. I am overseeing the work there and am initiating research into the cause for figure in trees. I'm working closely with professors and scientists, all of it first steps.

Meanwhile, PRT has also entered into a joint venture agreement with Taylor Guitars and Haleakala Ranch, a property on Maui, to source koa. The venture, called Paniolo Tonewoods, enables PRT to access limited quantities of koa planted on the ranch in the 1980s as a weed suppressant. There, koa grows at the correct elevation above sea level, and although the trees are not enormous, they have supported limited harvesting for guitar parts. Discovering that some of the harvested trees contained highly figured grain (but unsure if environmental conditions or genetics causes such figure), PRT employees along with Haleakala's ranch manager, Scott Meidell (with a prior background in watershed management) speculated that re-sprouts from basal buds could become a novel means to restock and enlarge the Ranch's koa estate. At Haleakala, basal shoots were propagated, and re-planted adjacent to the 1980s stands. With specialist care from horticulturalists who know the plants are destined to become guitars, the goal is to grow and care for koa, to deliver a greater chance of highly valuable figured timber in lifetimes to come – while cutting fewer old growth trees to receive the same amount of useable material. In the meantime, growing koa will suppress weeds, and provide habitat for native flora and fauna.

Encouraged by the Haleakala experience, PRT also developed a partnership with Kamehameha Schools (a Hawaiian educational trust operating since 1887 via an endowment from Hawaiian princess Bernice Pauahi Bishop, and now Hawai'i's largest private landowner). On 500 ha of Kamehameha land at Hōnaunau, PRT salvage koa from degraded plantation trees, extracting small amounts of wood in return for koa-'ō'hia forest conservation services. In yet another partnership, Bob Taylor from Taylor Guitars purchased 230 ha of pasture outside of Waimea, on Hawai'i Island, at the ideal elevation to grow koa. Paniolo Tonewoods will lease the land, planting koa and other native species over coming years. McMinn enthuses about such experiments, keen to move beyond simply cutting wood, towards a newfound love of silviculture.

Also in Hawai'i, Bob Russell works with several private landowners to manage existing koa trees and support new planting programs. Russell's pitch to landowners draws on both moral and emotional elements. 'I just tell people', Russell shouts as we hike through thick forest

understorey looking for a big tree that came down in a recent storm, 'growing koa is contributing to the native ecology of our land; it's something people will look back on in thirty years and be proud of'.

2.4. Beyond human timescales

Beyond land availability, guitar timber actors wrestle with the absolute time-reckonings of industrial forestry. In their various experiments, they are conscious of the minimum times required to grow harvestable trees, and that the trees will be extracted if viable. In the Eumundi stands in Queensland, every two years or so Kirby cuts a handful of individual bunya and/or quandong trees of sufficient girth for guitars. Others are left for future use:

> We took the most civilised route. You see here, stumps from trees we've taken. The criteria I put forward for harvesting is: the trees are old enough and there's a mixture of other species nearby [to replace them]. You can see that we've hit this area reasonably hard, but look: we have a canopy; the remaining trees have filled the gap.

Meanwhile, the bulk of Kirby's work managing the stands involves maintenance and restoration (e.g. weeding and fencing to prevent cattle from eating seedlings) in line with a longer-term view. Everyday 'plant-based care work' (Graddy-Lovelace, 2018:1) is required to maintain the stands and thus to maintain the future supply of tonewood-suitable trees. Overgrowth is thinned to enable re-sprouts to find sufficient light, while juvenile bunya pine trees in the stand are regularly pruned. Such pruning practices (Fig. 1) were once undertaken by foresters in the 1930s and 1940s in order to ensure maximum useable lengths of trunk decades into the future. No longer conducted on remnant plantations in Queensland state forests, Kirby leant about preferred pruning for bunya (proportion of branches at given time intervals) by seeking out and talking at length with retired public service foresters.

Such timber experiments re-imagine time as if calibrated by trees, not atomic clocks (cf. Bastian, 2012). At Utopia, PRT advise that 'any trees grown as a result of our efforts would not be harvested for some decades. Perhaps our grandchildren will play guitars made from them'. Asked if he has an unusual perspective on time, Kirby says:

> Oh, for sure. I very rarely know what day of the week it is, and my time's my own. But more to the point, is the time it takes for a tree to grow to a maturity that you can use in an instrument. It's more often than not longer than a human's lifetime… A hardwood tree isn't worth cutting into, quality wood, under 45 years and really 60 years is more like it. And in Tasmania, they really need to be cutting 100-year-old trees there because of the age that their forest achieves. So, it's all relative to that. It's not fair to cut a forest of trees that would happily grow to 200 years before they ever mature. … That's not right.

As another interviewee said, matter-of-factly: 'It takes 200 years to grow a good tree, and bloody seven minutes to cut it down'.

Each of these resource actors were keen to point out the ecological benefits of their experiments, and a broader understanding of multi-species dependencies. According to Kenway: 'When you plant local species, in a mixed way, there's less risk, because the bugs and the floods and the droughts, they're all used to it. They support each other'. Time and care are involved – with expertise distinctive from in monocultural plantations because of the multi-species dimension. As he shows us around one property, Kenway notes:

> In the gullies you'll see we're not mowing in there. We planted it for a closer canopy. If we didn't prune there would be much thicker canopy but we don't want branching… It's complex. The pruning is complicated, the knowledge needed… When you're doing a mixed species plantation, the complexity compared to one species, it's multiplied by a hundred even. Not just the fact that it's ten species and you're worried about ten, it's how the pruning of that tree effects the one next to it which is a different species.

Invasives are a source of consternation. While there is the perennial temptation to seek total eradication, several have evolved towards a more tolerant view. Certain invasives provide temporary ground cover and weed suppression, especially in disturbed land. Weeding efforts thus involve discernment over which species to tolerate while cultivating slower-growing species that eventually dominate forest ecologies (cf. Atchison, 2015).

They also maintain emotional connections to the trees, as Kirby explained:

> Normally it's a pretty small part of my time in my year. But this year because of the drought I wasn't willing to let the trees die. In hindsight, I should have let the bastards die!… Now I've invested in those trees so much more time that I can't let them die.

At times, such actors effuse on the quick early growth rates of their experiments. Nevertheless, they know they'll not likely see the financial and material benefits personally. Bob Taylor says of the Hawaiian experiments with PRT and Haleakala, that 'we are looking ahead a century' (quoted in Wood, 2017). In David Kirby's words:

> the sense of doing things that you're going to reap the rewards in your own lifetime, it's not how I can think. Otherwise I can't get up in the morning and do what I do. I'm planting, pruning and caring for a forest of trees that I'm not going to harvest… What has my lifespan got to do with it?

Kenway says that his experiments appeal to legacy mentality and a green-leaning philanthropic sentiment among affluent landowners:

> All my clients say it's the best thing they've ever done. They're in their business world and they're made of money, but something like growing a forest … You're on your deathbed and you're thinking, "Well, that was pretty cool. That's still there".

While there is much hope surrounding their experiments, there is an equal dose of uncertainty. Supporting forestry science is either playing catch-up or simply non-existent. No one definitively knows how quickly the trees will grow, whether ecological restoration goals will be met, and how much volume of useable high-quality wood will result. To attract participating landowners, Kenway is working on a model that delivers harvestable trees in 40 years. That may prove correct for furniture making, depending on the dimensions of timber required; Kirby's insights on salvaged blackwood for the guitar industry suggest a timescale more in the range of 80–100 years for provision of sufficiently wide boards, while respecting the tree's lifespan. Such timeframes raise immediate questions about intergenerational knowledge transfer. It remains to be seen whether those who inherit responsibility for forest stewardship will continue to 'do the right thing', maintaining everyday pruning and weeding practices, and harvesting sustainable quantities. Resolving arboreal time with market exigencies will likely still prove difficult.

Uncertain methods also call for novel prosaic technologies and everyday relations of care with seedlings and sprouts, soil and water, knowing that some experiments will fail. At PRT's maple trials at Utopia, early attempts used tissue culture to propagate maple, but the resulting sprouts died in a dry summer spell. As McMinn recalls:

> We're a lot further along than we used to be… And you can see there's a lot of stuff that's just hokey… All this stuff, you have to learn. You start down this path and "Oh, well, we've got to step over this, and step around this".

At Haleakala, swift growth of seedlings spurred hope that koa could mature within a shorter time horizon than originally planned. But how old plantation koa must be before harvesting selectively is unclear. Nowhere in Hawai'i are managed plantations old enough to generate

conclusive data. What bestows a given tree or stump with highly figured, highly valuable timber, is also uncertain. Both genetics and environmental context appear to influence the level of figure, 'but to unknown degrees' (Baker et al., 2009:89). It could be a precise mix of soil chemistry, climate, aspect, wind, and sunlight, or attacks from funguses and bacteria that cause the timber to vary from regular grain patterns. As Hawaiian forestry researcher Nick Dudley (2003:80) quipped, 'planting koa is a bit like going to Las Vegas – it's a risk'.

The biggest uncertainty facing actors and their resource experiments is likely climate change. Kirby admits that many planted trees may not survive:

> It could be a massive fuckup on everything I've done in my life. But at the end of the day, what if you don't do it? It's that very thing: if everybody planted trees for future generations, of course, that would help stop climate change. I can't be the one to say I'm not going to plant trees because they might not survive.

In Hawai'i, the race is on to re-establish higher altitude koa forests, and trigger associated moist microclimates, before warmer, drier conditions engulf the islands. More frequent and extreme hurricans are expected, hampering restoration efforts, though with its remarkable re-sprouting ability, koa is better-placed than other native species to regenerate (Baker et al., 2009:41). Hawaiian forests' delicate interdependencies may prove more difficult to restore. Dedicated plantations need understory vegetation that gives wet montane forests their ecological structure. The Greater Koa Finch (*Rhodacanthis palmeri*), *Elepaio* (*Chasiempis sandwichensis*) and other birds who digested and distributed seeds and kept insect populations in check, are now endangered or thought extinct. Wildfires – more common from climate change but also the presence of invasive species (as fuel) – may actually stimulate koa seeds to germinate (likely a genetic inheritance from koa's Australian ancestors). Counterbalancing this is that koa, in order to flourish, needs a certain amount of precipitation, which is expected to become less reliable in Hawai'i as climate change intensifies.

At Haleakala, Meidell has come to accept that predictions of escalating drought are 'the new normal' (Wood, 2013). Biodiversity and promoting native re-forestation not only improve the Ranch's environmental record, but also maximise the likelihood of encouraging moist microclimates, mitigating exposure to more extreme droughts. Propagating koa vegetatively in situ rather than introducing seedlings grown in nurseries elsewhere assists juvenile plants to adapt to local micro-climate and conditions (Baker et al., 2009:66). The Ranch is also helping to restore the Pu'u Pahu Reserve's 1200-acre alpine shrub ecosystem as a buffer zone for nearby Haleakala National Park, anticipating the range of wet and dry forests may shift on the volcano. And, after 130 years as a ranch, Haleakala is moving away from a dependence on cattle, towards a 'carefully managed multispecies operation' that includes goats (viewed not as pest but weapon against gorse weeds), chickens, sheep, and koa.

Stitched across these experiments is a sense of trial and error that the various actors feel is worth undertaking. As we accompany them explaining forest ecology, describing their bespoke propagating technologies, and witness them in energetic conversation with horticulturalists, curiosity and enthusiasm are palpable (cf. Brace and Geoghegan, 2010). Anthropologist Tim Ingold (2018) aptly describes this kind of unfolding exercise as a disposition to accept and adapt to the earth's material vagaries: a 'responsiveness' to unfurling circumstances. The goal is to restore forests as ongoing legacy spaces, so that future generations can gradually take from them small numbers of trees for guitars, even knowing that climate change is escalating and that their genetic bets on cultivating other kinds of forests for timber may not pay off. As one put simply, 'It's for our grandkids. To make sure that wood is still available, still there'. There is a sense of proceeding strategically without the benefit of a tried-and-tested playbook, but all involved are keen to try, regardless.

3. Conclusions

The Anthropocene compels diversification in human ecological relations, beyond the homogenising tendencies and compressed space-time regimes of industrial modernity. Here we have sought to document how spaces in which to live, work, co-mingle and comprehend time beyond the chronotopes of capitalist modernity are already under construction. On the fringes of formal industries and beyond the scope of official governmental planning for climate change adaptation, are experimenters who through necessity and a passion for forests are planting seeds to help future humans face an uncertain future. While capitalism 'emerged out of nature' (Moore, 2015), drawing wealth from it while also disrupting, degrading and defiling ecologies, here are different, emergent nature-society relationships. Instead of degradation and defilement, experiments enable nonhuman others to diversify, replenish and regenerate.

Modelling of climate impacts on forests has revealed 'considerable uncertainty', with best-case and worst-case scenarios 'varying from decreased to increased production' (Battaglia and Bruce, 2017:216). Exactly how warming, drought or more highly variable precipitation will impact on trees and landscape-scale forest health is essentially unknown (Loehman et al., 2011). Forest managers 'will need to accept a shift away from certainty of outcome, to a more probabilistic understanding of the influences of climate' (Pinkard, 2017:195). The assumption of a stable state for forest plantations 'implies that a single developmental pathway or trajectory is normal… when there should be at least as many developmental pathways as there are different stand structures' (O'Hara, 2016:4). Nevertheless, forest policy amidst climate change remains underwhelming, often based on assumptions without scientific evidence (Taylor et al., 2013). Meanwhile a dearth of monitoring hampers attempts to assess the longer-term efficacy of climate change adaptation initiatives and impacts on forest structure and function (Six et al., 2014). The forestry industry appears locked into single species, monocultural models, even as forestry scientists urge experimentation and diversity in seed collecting, plantings and spatial locations of forest trials in anticipation of diverse impacts and unprecedented environmental stress (Keenan, 2017). The chronotopes of plantations and rotations are stubbornly fixed on maximising productivity and profitability (Keane et al., 2017; Grant et al., 2018; cf. Castree, 2009). Within mainstream forestry there appears little space for contemplation of unknown futures.

Even if those maintaining the status quo appear unwilling to budge from a likely catastrophic course, other experiments are unfolding in liminal and fringe spaces (Stengers, 2015; Klocker et al., 2018). This paper has sought to draw to light one such example. In this case, experiments for unknown futures are found among those very workers whose livelihoods depend on extracting materials from nature, transforming and then selling them as a resource for humans to manufacture material things (cf. Carr and Gibson, 2016). Critique arises not just in the form of academic analysis of commodified nature (cf. Castree, 2003), but also from *within the extractive* enterprise itself. Experiments emerge not from deliberative industry or public policy initiatives (cf. Lorimer and Driessen, 2014), but from 'prosaic restorative cultures' (Carr, 2017: 642) constituting those who grapple with the limitations of industrial modernity within their working lives (cf. Almassi, 2017). Such experiments in new chronologies of foresting are pursued by resource actors aiming to resolve their own extractive dependencies through their embodied understandings of trees and forest ecologies.

Key to making sense of resource experiments is disentangling competing spatio-temporalities. Temporalities collide in resource use, especially concerning trees, timber, and forests. On the on hand is industrial forestry, which 'has economic growth for its arrow of time' (Stengers, 2015:18). In an era of speeded-up and yet also risk-adverse forestry, private interests and government agencies appear unwilling to invest time and money in widespread experimentation for the longer-term. On the other hand are an eclectic group of actors grappling with

resource scarcities unleashed by mainstream forestry's proclivities. While industrial forestry seeks to domineer biological time to maximise reliable returns, it remains exposed to real climate risks (including threats from fire, drought and invasives), in asymmetry with the temporality of trees (cf. Prudham, 2005). Resource experimenters profiled here are grappling with such contradictions, responding to the problem that trees take many human lifetimes to mature into specimens worth harvesting for guitar timber. They are, in Krohn-Hansen's (2018: 180) words, 'involved agents' who 'seek to adapt to, and work on the effects of, the conflicts between rhythms'. Their experiments are not so much a form of deliberate climate resilience as examples of grounded and unfurling resourcefulness in service of forethought (cf. MacKinnon and Derickson, 2013; Brace and Geoghegan, 2010).

We concede that it is not clear how widespread such experiments are. Arguably, we have merely identified a few players on the fringe of forestry connected to a niche industry, tiny in comparison with industrial forestry and the spatial extent of forests over which corporate and government interests hold court. As David Kirby admitted: 'it's not serious money, and it's not a serious enough plot. 50 acres. For timber stands that's nothing. … Not even a quarter of a logging area when in southeast Queensland there's hundreds of logging areas. So as far as supply for a massive future industry goes, no, not at all'. Smallness in the face of monolithic industrial forestry nevertheless points to the presence of diversity and experiment amidst the dominant order (cf. Klocker et al., 2018). To echo David Harvey's (2000) words, within commercial worlds dependent on natural resources 'insurgent architects' are at work upending the dominant way of things. Added to the 'speculative imagination which he or she necessarily employs', through their concrete experiences of industrial forestry's limitations, such resource actors have available 'some special resources for critique, resources from which to generate alternative visions as to what might be possible' (Harvey, 2000:237–238). Beyond a chronotope that reproduces what is easily calculable and dependable, such actors seek an extended, riskier, more open-ended and inclusive span of time and space (cf. Osborne, 2018). As David Kirby went on to explain, 'I guess I just have to do this because otherwise you'd feel pretty bad cutting down those trees into sawdust. I guess that's pretty much the truth of it'. The central contradiction – that individuals whose livelihood depends on the exploitation of trees as a resource, also express strong connections with forests as multi-species ecologies, and thus care about their future – helps ensure experiments take place.

Such experiments also illustrate the efforts humans must undertake to survive the future we have wrought. Grounded attempts to navigate modernity's temporal contradictions include the 'virtue of temporal discernment', to 'live well as earthly creatures' (Hatley, 2012:1) by more effectively keeping time with trees. Growing trees for future use with open timespans seeks to realign temporal dimensions of human resource use with those of other beings (Metcalf and van Dooren, 2012: vi). Experimentation seeks to grow and restore mixed/mature forests not as a return to 'wilderness' (cf. Kirkman, 2012), but to provide future generations with possibilities to sustain instrument-making in tune with arboreal time, all while improving ecological health. The vision is of 'the cultivation of relationships and flourishing that must change through time' (Metcalf and van Dooren, 2012: vii). Experiments with foresting are active and unfolding, redefining relationships and reimagining longer-term possibilities of living together with trees beyond the fixed, static frames of 'plantation', 'old growth' and 'wilderness' (cf. Bingham and Hinchliffe, 2008; Kirkman, 2012; Wright, 2012). In the unassuming moments of the here-and-now, such actors press ahead with foresting experiments, not knowing whether they will prove sustainable or economically-viable, but certain it will take many generations beyond their own for trees to grow into guitars.

4. Postscript

A few weeks after departing Hawai'i, we learnt of the sad passing of koa expert, Bob Kalani Russell, from a painful battle with cancer. Sharing our sense of adventure, Bob had spent several days with us in our search for koa trees, hiking through dense forests in the heat and humidity and, unbeknownst to us, risking his own health. There is a Hawaiian saying, *e ola koa* ('live a long time, like a koa tree in the forest') that captures a sense of longevity, resourcefulness, wiliness, endurance, in the face of human hubris. Grateful and humbled that Bob shared his deep knowledge with us in his final days, we hope his Hawaiian spirit has settled in its rightful place for centuries to come among the koa trees.

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